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FUEL CONSUMPTION TEST OF DH-4B WITH LIBERTY "12" ENGINE

(FLIGHT TEST REPORT No. 77)

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REPORT ON FUEL CONSUMPTION TEST OF DH-4B WITH LIBERTY "12" ENGINE.

OBJECT OF TEST.

The object of this test was twofold:

(1) To determine the fuel consumption of the Liberty engine in a DH-4B at various speeds and altitudes.

(2) To determine the value of the Schroeder Econometer as a means of measuring fuel consumption.

SUMMARY OF RESULTS.

Full throttle consumption was as follows:

Altitude.	True air speed, miles per hour.	Revolutions per minute.	Consumption (gallons per hour).
2,000 feet	119	1,720	37.1
5,000 feet	116	1,710	34.0
8,000 feet	113	1,680	30.0

Consumption at various throttle settings is shown in Figure 1 and the accompanying table. A method of using Figure 1 to determine the most economical speed is shown in Figure 2.

Figure 3 gives a comparison of flow as determined by the Schroeder Econometer and by timing the consumption of a measured quantity of gasoline by stop watch. Considering the fact that the flow was very unsteady, the readings of the Econometer are surprisingly accurate. When tested in the laboratory, the instrument responds very quickly to changes in flow, its lag being less than one-fifth of a second, and after a change shows practically no tendency to oscillate about its new position. In flight there is considerable oscillation, due probably to actual variations in the flow.

RECOMMENDATIONS.

The instrument should read at least 25 per cent higher than the maximum average flow to be measured. A photographic means of recording its readings should be developed.

METHOD OF CONDUCTING TEST.

An auxiliary gasoline tank with glass gauge was installed in the rear cockpit, the piping and valves being so arranged that either the main tank or the auxiliary tank could be connected to the carburetor. The airplane was flown level at a given throttle setting until its motion became steady. The auxiliary tank was then connected, the main tank disconnected, and the time was taken by stop watch between marks on the glass gauge. Readings of airspeed and revolutions per minute and as many readings as possible of the econometer were taken while the auxiliary tank was being emptied. The econometer was connected between the auxiliary tank and the carburetor, thus giving a check upon its readings. At all times during these tests the mixture control was adjusted to give the best engine operation.

Table showing consumption at various altitudes.

ALTITUDE 2,000 FEET.

True air-speed (M. P. H.).	Revolutions per minute.	Consumption (gallons per hour).
119	[1] 1,720	37.1
110	1,610	26.4
100	1,485	20.2
90	1,375	17.2
80	1,285	15.2
70	1,200	13.7

ALTITUDE 5,000 FEET.

116	[1] 1,710	34.0
110	1,650	27.5
100	1,520	20.7
90	1,425	17.5
80	1,345	15.4
75	1,300	14.6

ALTITUDE 8,000 FEET.

113	[1] 1,680	30.0
110	1,650	25.8
100	1,515	19.8
90	1,430	17.2
80	1,365	15.6

[1] Full throttle.

DESCRIPTION OF ECONOMETER.

The operation of the Econometer is as follows:

The gasoline flows in at the bottom of a vertical slotted cylinder, forcing upward a light aluminum piston. The piston, as it rises, uncovers a portion of the slot, allowing the gasoline to flow out into the glass chamber which incloses the cylinder.

The pressure difference between the inside and the outside of the cylinder is constant, and depends only on the weight of the piston and the area of its circular cross section. The flow through the slot is therefore directly proportional to the area of slot uncovered, or conversely the area of slot uncovered is directly proportional to the flow. (This condition holds only when the slot is long in proportion to its width, which is the case except for very low rates of flow, when the piston approaches its lowest position.)

An indicating hand is attached to the piston and moves over a scale, reading length of slot uncovered in inches. For any particular liquid, these readings may be converted into units of volume flowing per unit of time. Due to variations in density and viscosity, the readings vary for different liquids. Variations in pressure, however, have no effect.

Photograph of instrument shown in Figure 4.

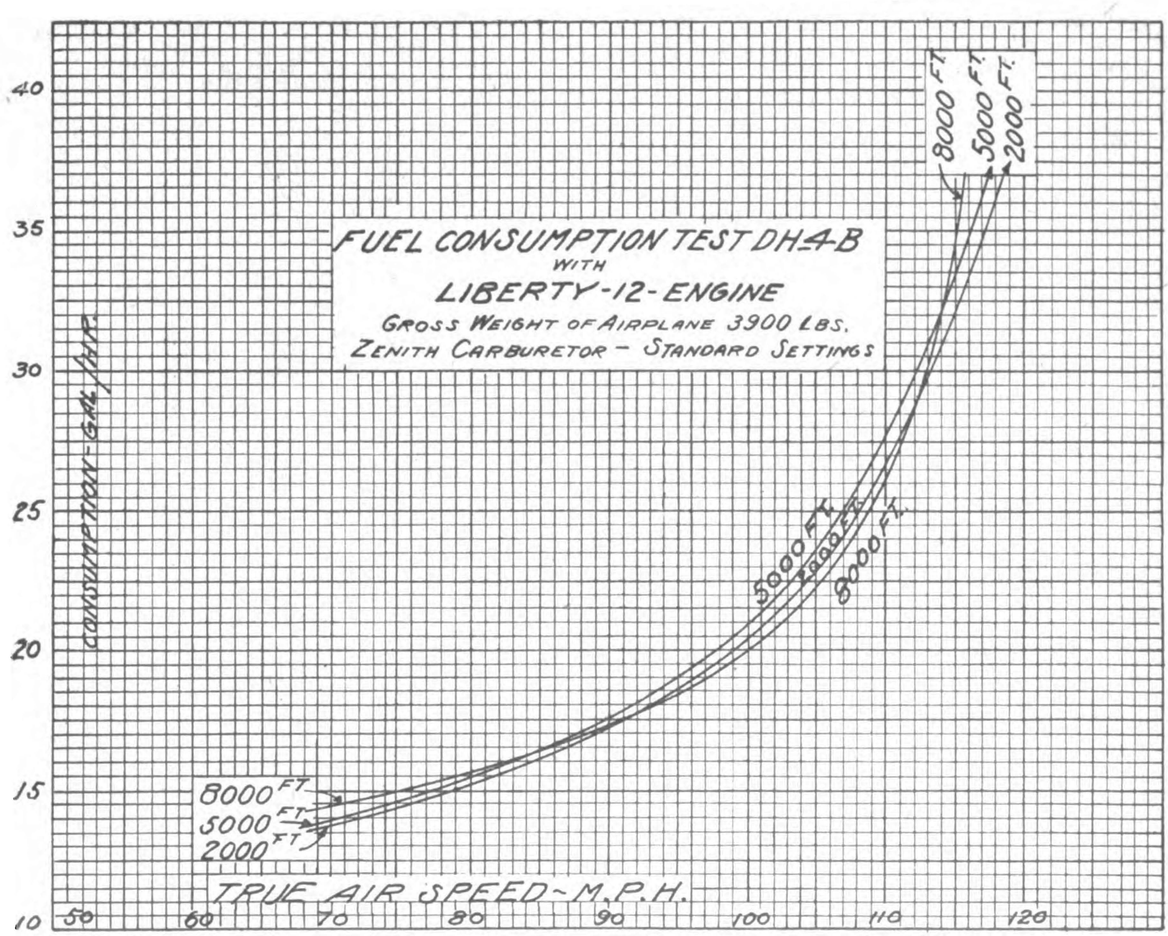

FUEL CONSUMPTION TEST DH-4-B
WITH
LIBERTY-12-ENGINE
GROSS WEIGHT OF AIRPLANE 3900 LBS.
ZENITH CARBURETOR - STANDARD SETTINGS
CONSUMPTION - GAL./HR.
TRUE AIR SPEED ~ M.P.H.
8000 FT.
5000 FT.
2000 FT.
10
15
20
25
30
35
40
50
60
70
80
90
100
110
120

FIG. 1.

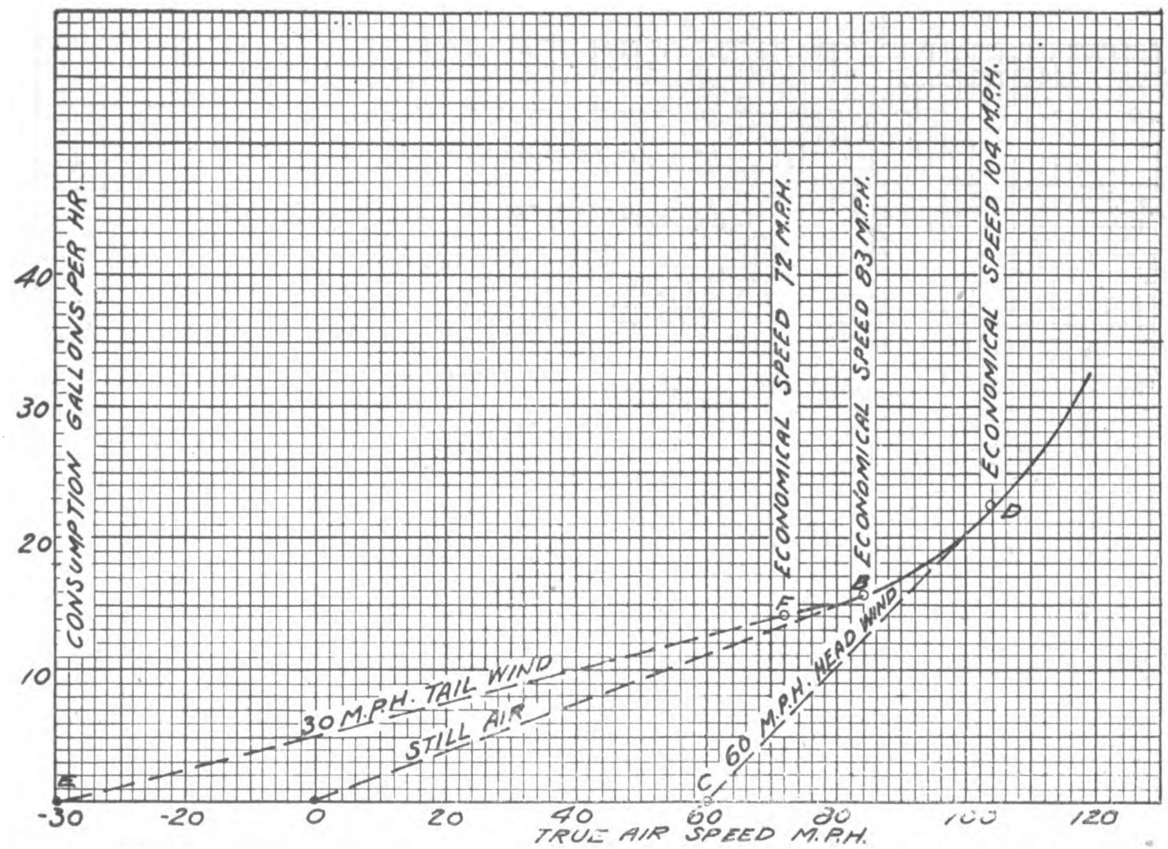


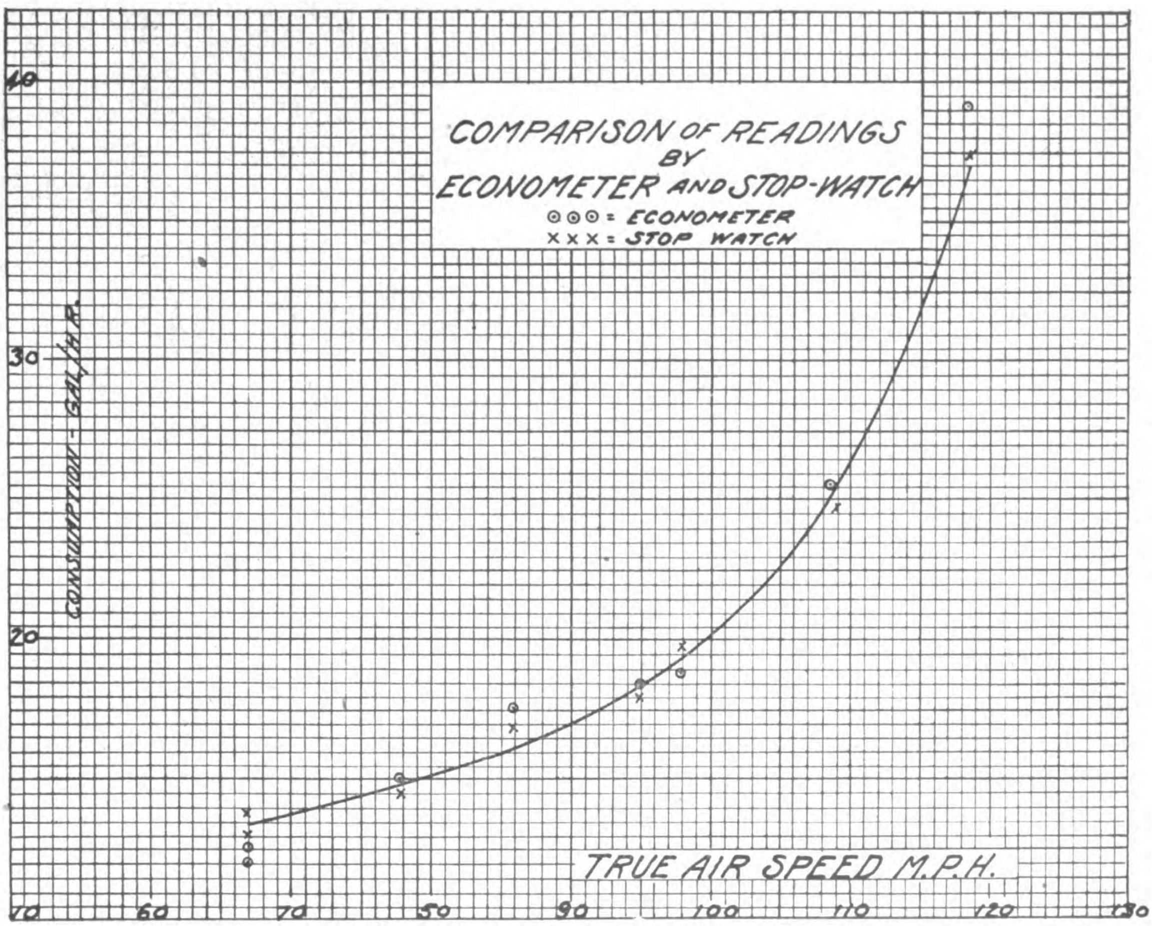
FIG. 2.

TO FIND MOST ECONOMICAL SPEED.

For still air, draw line OB through O and tangent to curve. Point of tangency gives most economical speed.

If airplane is traveling against the wind, lay off the velocity of the wind to the right of O and draw tangent from that point. (Line CD show 60 miles per hour head wind.)

If airplane is traveling with the wind, lay off velocity of the wind to the left of O. (Line EF shows 30 mi'es per hour tail wind.)



COMPARISON OF READINGS BY ECONOMETER AND STOP-WATCH
⊙⊙⊙ = ECONOMETER
××× = STOP WATCH
CONSUMPTION - GAL./H.R.
40
30
20
TRUE AIR SPEED M.P.H.
70
60
70
50
90
100
110
120
130

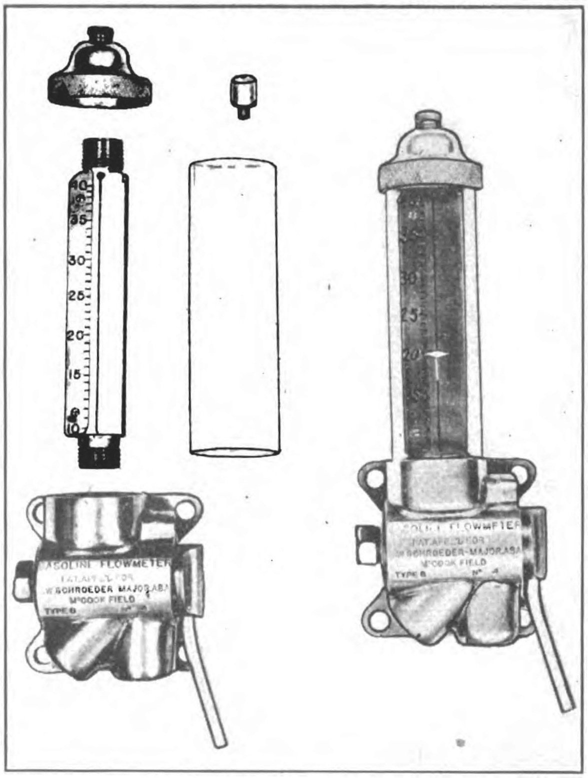


Fig. 4.